Jay Lepreau

Curriculum Vita

March 16, 2004

University of Utah
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Research Interests

Systems, including operating systems, distributed systems, and networks; and improved ways to construct and evaluate them, including through components, languages, and testing.

Key Achievements

- Led research which made significant contributions to OS structure, interprocess communication, compilation of interface definition languages, component software, language-based operating systems (with Hsieh), and network experimentation. Recent examples of major impact are the imminent addition to the Java standard of a process-like entity, and the establishment of the "automated cluster testbed" as a new way to perform experimental research. Ongoing work includes seeking to establish a general-purpose experimental environment that is unified across disparate resources.
- Led the building of the Utah software systems group to a 19th ranking, with my gradually-recruited colleagues.
- Conceived and founded the OSDI conference series, which achieved immediate academic prestige, and which Citeseer ranks first in impact among 1200 CS publication venues.
- Received over $25M in research support since 1994, as Principal Investigator.

Professional Employment

2000–present	Research Associate Professor, School of Computing	University of Utah
1997–2000	Research Assistant Professor, Dept. of Computer Science	University of Utah
1990–1998	Assistant Director, Computer Systems Laboratory	University of Utah
1983–90	Manager, Systems Programming, Dept. of Computer Science	University of Utah

Education

B.S. 1983 University of Utah, Salt Lake City, UT Computer Science

Professional Service

Conference Series Founder: Symposium on Operating Systems Design and Implementation (OSDI), 1994. *Ranked first in impact among CS publication venues by Citeseer/DBLP, out of 1221*, April 2001 — present.

Program Committee Chair: First Symposium on Operating Systems Design and Implementation (OSDI '94)

Program Committee Co-Chair: 1984 Summer Usenix Conference

Program Committee Member:

SIGCOMM 2004
Workshop on Models, Methods and Tools for Reproducible Network Research (2003) (in conjunction with SIGCOMM)
Fifth Symposium on Operating Systems Design and Implementation (OSDI 2002)
Fifth IEEE Conference on Open Architectures and Network Programming (OpenArch 2002)
17th ACM Symposium on Operating Systems Principles (SOSP 1999)
Second Conference on Domain-Specific Languages (1999)
Third ECOOP Workshop on Mobile Object Systems (1997)
Second Symposium on Operating Systems Design and Implementation (OSDI 1996)
Inaugural SIGPLAN–SIGOPS Workshop on Compiler Support for System Software (1996)
1993 Usenix Mach Symposium
1988 Summer Usenix Conference
1987 Summer Usenix Conference

JSR-121 Java "Isolate" specification process: Pat Tullmann, a member of our research group, formally represented the University of Utah on the small Expert Group that developed the JSR-121 standard, and in which he took a leading role. May 2001–2003.

Emulab/Netbed testbed: conceived ('98), developed ('99–present), and provided (10/00–present) this unique and popular facility, for the research community, that has established the "cluster testbed" as a new way to perform experimental research. Extended it to transparently include nodes and links that are geographically-distributed (5/02), purely simulated (12/02), multiplexed virtual (8/03), PlanetLab nodes (9/03), and specialized network processor nodes (10/03). To date, used by approximately 200 external and 15 internal projects, an entire DARPA program, and 14 external classes. Ten other universities and labs have built or are building their own Emulabs, including a 625-node wireless testbed, using our software.

Organizing committee, "NSF Workshop on Network Research Testbeds," October 2002–November 2002. Workshop Report available at `http://gaia.cs.umass.edu/testbed_workshop/`; the report is the major force behind a new $10M NSF program, "Networking Research Testbeds," NSF 03-358.

Invited member, DARPA "Netvision 2012" workshop series on the "Future of Network Research," October 2002–April 2003.

Panelist, Workshop on "Accelerating Trustworthy Internetworking," Palo Alto, CA, September 2002.

Invited member, DARPA Information Science and Technology (ISAT) study group, topic: "Mobility and Security," January–July, 2000.

Invited member, NSA/DARPA study group on "Secure Open Source Operating Systems," November 1999–November 2000.

Invited member, INFOSEC Research Council Science and Technology Study Group on "Malicious Code," October 1999–March 2000.

Invited Group Leader, topic: "Security, Assurance, and Robust Systems": NSF Workshop on "New Challenges and Directions for Systems Research" (July 1997).

Coordinator of student scribes for conference record, 17th ACM Symposium on Operating Systems Principles, December 1999.

Member: Association for Computing Machinery, Usenix Association, IEEE Computer Society, IEEE Communications Society

Recent Service to the School of Computing

Graduate Admissions Committee, 1998–99, 2003–04.

Ad-hoc Systems Faculty Recruiting Committee, 1990–92, 1995–2003.

Colloquium Chair, 1998–99, 1999–00.

Web Chair, 1998–99, 1999–00.

Ad-hoc "Future of the Department" Committee, 1999.

Computer Policy/Facility Committee, 1995–1998

Distinguished Lectures

Samuel D. Conte Distinguished Lecturer, Purdue University Department of Computer Science, "Bringing Principles to Pragmatists: Components for Systems Hackers," November 20, 2000.

Publications Availability Note

Essentially all publications are indexed and available online at
`http://www.cs.utah.edu/flux/papers/`

Publications – in Books

P. Hoogenboom and J. Lepreau, "Computer System Performance Problem Detection Using Time Series Models," in *Selected Papers in Network and System Administration*, John Wiley and Sons, NY, NY; E. Anderson, M. Burgess, and A. Couch, editors. 2002, pp. 159–176. (Paper originally published in 1993.) Excerpt from editors' written commentary: *"This fascinating paper was far ahead of its time."*

E. Eide, J. Lepreau, J. Simister, "Flexible and Optimized IDL Compilation for Distributed Applications," in *Languages, Compilers, and Run-time Systems for Scalable Computers*, Lecture Notes in Computer Science, Vol. 1511, D. Hallaron, Editor, Springer-Verlag, 1998, pp. 288–302.

D. Orr, R. Mecklenburg, P. Hoogenboom, J. Lepreau, "Dynamic Program Monitoring and Transformation Using the OMOS Object Server," in *The Interaction of Compilation Technology and Computer Architecture*, Kluwer Academic Publishers, D. Lilja and P. Bird, Editors, March 1994.

Publications – Journals

R. Ricci, C. Alfeld, J. Lepreau, "A Solver for the Network Testbed Mapping Problem," *ACM SIGCOMM Computer Communication Review (CCR)*, 32(2):65–81, April 2003.

P. Tullmann, M. Hibler, J. Lepreau, "Janos: A Java-Oriented OS for Active Network Nodes," *IEEE Journal on Selected Areas in Communications*, 19(3):501–510, March 2001.

L. Peterson, Y. Gottlieb, M. Hibler, P. Tullmann, J. Lepreau, H. Dandekar, S. Schwab, A. Purtell, J. Hartman, "An OS Interface for Active Routers," *IEEE Journal on Selected Areas in Communications*, 19(3):473–487, March 2001.

E. Eide, J. Simister, T. Stack, J. Lepreau, "Flexible IDL Compilation for Complex Communication Patterns" in *Scientific Programming*, IOS Press, 7(3, 4):275–287, 1999.

Publications – Refereed Conferences

E. Eide, T. Stack, J. Regehr, J. Lepreau, "Dynamic CPU Management for Real-Time, Middleware-Based Systems," to appear in the *10th IEEE Real-Time and Embedded Technology and Applications Symposium (RTAS 2004)*, Toronto, Canada, May 2004. [Acceptance rate TBD]

J. Regehr, A. Reid, K. Webb, M. Parker, J. Lepreau, "Evolving Real-time Systems using Hierarchical Scheduling and Concurrency Analysis," in *Proceedings of the 24th IEEE International Real-Time Systems Symposium (RTSS 2003)*, Cancun, Mexico, December 2003. [Acceptance rate 17%]

P. Patel, A. Whitaker, D. Wetherall, J. Lepreau, T. Stack, "Upgrading Transport Protocols using Untrusted Mobile Code," in *Proceedings of the 19th ACM Symposium on Operating Systems Principles (SOSP 2003)*, Bolton Landing, NY, October 2003, pp. 1–14. [Acceptance rate 17%]

M. Hibler, L. Stoller, J. Lepreau, R. Ricci, C. Barb, "Fast, Scalable Disk Imaging with Frisbee," *Proceeedings of the 2003 Usenix Technical Conference*, San Antonio, TX, June 2003, pp. 283–296. [Acceptance rate 23%]

P. Patel and J. Lepreau, "Hybrid Resource Control for Active Extensions," *Proceedings of the Sixth IEEE Conference on Open Architectures and Network Programming (OpenArch 2003)*, San Francisco, CA, April 2003, pp. 23–31. [Acceptance rate 25%]

T. Stack, E. Eide, J. Lepreau, "Bees: A Secure, Resource-Controlled, Java-Based Execution Environment," *Proceedings of the Sixth IEEE Conference on Open Architectures and Network Programming (OpenArch 2003)*, San Francisco, CA, April 2003, pp. 97–106. [Acceptance rate 25%]

B. White, J. Lepreau, L. Stoller, R. Ricci, S. Guruprasad, M. Newbold, M. Hibler, C. Barb, A. Joglekar, "An Integrated Experimental Environment for Distributed Systems and Networks," *Proceedings of the Fifth Symposium on Operating System Design and Implementation* Boston, MA, December 2002, pp. 255–270. [Acceptance rate 18%]

E. Eide, A. Reid, J. Regehr, J. Lepreau, "Static and Dynamic Structure in Design Patterns," *Proceedings of the 24th International Conference on Software Engineering (ICSE 2002)*, Orlando, FL, May 2002, pp. 208–218. [Acceptance rate 15%]

A. Reid, M. Flatt, L. Stoller, J. Lepreau, E. Eide, "Knit: Component Composition for Systems Software," *Proceedings of the Fourth Symposium on Operating Systems Design and Implementation*, San Diego, CA, October 2000, pp. 347–360. [Acceptance rate 21%]

G. Back, W.C. Hsieh, J. Lepreau, "Processes in KaffeOS: Isolation, Resource Management, and Sharing in Java," *Proceedings of the Fourth Symposium on Operating Systems Design and Implementation*, San Diego, CA, October 2000, pp. 333–346. [Acceptance rate 21%]

K. Wright, S. McCanne, J. Lepreau, "A Reliable Multicast Webcast Protocol for Multimedia Collaboration and Caching," *Proceedings of the Eighth ACM Multimedia Conference*, Los Angeles, CA, November 2000, pp. 21–30.

G. Back, P. Tullmann, L. Stoller, W.C. Hsieh, J. Lepreau, "Techniques for the Design of Java Operating Systems," *Proceedings of the 2000 Usenix Technical Conference*, San Diego, CA, June 2000, pp. 197–210.

R. Spencer, S. Smalley, P. Loscocco, M. Hibler, D. Andersen, J. Lepreau, "The Flask Security Architecture: System Support for Diverse Security Policies," *Proceedings of the 8th Usenix Security Symposium*, Washington, DC, August 1999, pp. 123–139.

B. Ford, M. Hibler, J. Lepreau, R. McGrath, P. Tullmann, "Interface and Execution Models in the Fluke Kernel," *Proceedings of the Third Symposium on Operating Systems Design and Implementation*, New Orleans, LA, February 1999, pp. 101–115. [Acceptance rate 20%]

B. Ford, G. Back, G. Benson (U.C. Davis), J. Lepreau, A. Lin (MIT), O. Shivers (MIT), "The Flux OSKit: A Substrate for OS and Language Research," *Proceedings of the 16th ACM Symposium on Operating Systems Principles*, St. Malo, France, October 1997, pp. 38–51. [Acceptance rate 20%]

E. Eide, K. Frei, B. Ford, J. Lepreau, G. Lindstrom, "Flick: A Flexible, Optimizing IDL Compiler," *Proceedings of the ACM SIGPLAN 1997 Conference on Programming Language Design and Implementation*, Las Vegas, NV, June 1997, pp. 44–56. [Acceptance rate 19%]

B. Ford, M. Hibler, J. Lepreau, P. Tullmann, G. Back, S. Clawson, "Microkernels Meet Recursive Virtual Machines," *Proceedings of the Second Symposium on Operating Systems Design and Implementation*, Seattle, WA, October 1996, pp. 137–151. [Acceptance rate 17%]

B. Ford and J. Lepreau, "Evolving Mach 3.0 to a Migrating Thread Model," *Proceedings of the 1994 Winter Usenix Conference*, San Francisco, CA, January 1994, pp. 97–114.

J. Lepreau, M. Hibler, B. Ford, J. Law, "In-Kernel Servers on Mach 3.0: Implementation and Performance," *Proceedings of the 1993 Usenix Mach Symposium*, Santa Fe, NM, April 1993, pp. 39–55.

D. Orr, J. Bonn, J. Lepreau, R. Mecklenburg, "Fast and Flexible Shared Libraries," *Proceedings of the 1993 Summer Usenix Conference*, Cincinnati, OH, June 1993, pp. 237–251.

P. Hoogenboom and J. Lepreau, "Computer System Performance Problem Detection Using Time Series Models," *Proceedings of the 1993 Summer Usenix Conference*, Cincinnati, OH, June 1993, pp. 15–32.

D. Orr, R. Mecklenburg, P. Hoogenboom, J. Lepreau, "Dynamic Program Monitoring and Transformation Using the OMOS Object Server," *Proceedings of the 26th Hawaii International Conference on System Sciences*, January 1993, pp. 232–241.

Publications – Workshops

P. Patel, D. Wetherall, J. Lepreau, A. Whitaker, "TCP Meets Mobile Code," full presentation at and appears in *Proceedings of the Ninth Workshop on Hot Topics in Operating Systems*, Lihue, Hawaii, May 2003. [Acceptance rate 22%]

B. White, J. Lepreau, S. Guruprasad, "Lowering the Barrier to Wireless and Mobile Experimentation," *Proceedings of the First Workshop on Hot Topics in Networks (Hotnets-I)*, Princeton, NJ, October 2002. Also in *ACM SIGCOMM Computer Communication Review (CCR) 33(1)*, January 2003. [Acceptance rate 20%]

J. Regehr and J. Lepreau, "The Case for Using Middleware to Manage Diverse Soft Real-Time Schedulers," *Proceedings of the 2001 International Workshop on Multimedia Middleware*, ACM, pp. 23–27. October 2001.

R. Ricci and J. Lepreau, "Active Protocols for Agile Censor-Resistant Networks," *Proceedings of the Eighth IEEE Workshop on Hot Topics in Operating Systems*, May 2001. [Acceptance rate 25%]

E. Eide, A. Reid, M. Flatt, J. Lepreau, "Aspect Weaving as Component Knitting: Separating Concerns with Knit," *Workshop on Advanced Separation of Concerns in Software Engineering at ICSE 2001*, 5 pages, May 2001.

P. Tullmann and J. Lepreau, "Nested Java Processes: OS Structure for Mobile Code," Presented at and appears in *Proceedings of the Eighth ACM SIGOPS European Workshop*, Sintra, Portugal, September 1998, pp. 111–117. [Acceptance rate 26%]

P. Tullmann, J. Turner, J. McCorquodale, J. Lepreau, A. Chitturi, G. Back, "Formal Methods: A Practical Tool for OS Implementors," *Proceedings of the Sixth IEEE Workshop on Hot Topics in Operating Systems*, May 1997, pp. 20-25. [Acceptance rate 28%]

B. Ford, S. Clawson, K. Van Maren, J. Lepreau, B. Robinson, J. Turner, "The Flux OS Toolkit: Reusable Components for OS Implementation," *Proceedings of the Sixth IEEE Workshop on Hot Topics in Operating Systems*, May 1997, pp. 14–19. [Acceptance rate 28%]

P. Tullmann, J. Lepreau, B. Ford, M. Hibler, "User-level Checkpointing Through Exportable Kernel State," Presented at and appears in Proceedings of the *Fifth IEEE International Workshop on Object Orientation in Operating Systems*, October 1996, pp. 85–88.

J. Lepreau, B. Ford, M. Hibler, "The Persistent Relevance of the Local Operating System to Global Applications," Presented at and appears in *Proceedings of the Seventh ACM SIGOPS European Workshop*, Connemara, Ireland, September 1996, pp. 133–140. [Acceptance rate 24%]

B. Ford and J. Lepreau, "Microkernels Should Support Passive Objects," *Proceedings of the Third IEEE International Workshop on Object Orientation in Operating Systems*, Asheville, NC, December 1993, pp. 226–229.

J. Carter, B. Ford, M. Hibler, R. Kuramkote, J. Law, J. Lepreau, D. Orr, L. Stoller, M. Swanson, "FLEX: a Tool for Building Efficient and Flexible Systems," *Proceedings of the Fourth Workshop on Workstation Operating Systems*, IEEE, Napa, CA, October 1993, pp. 198–202.

Publications – Other Refereed Forums

S. Guruprasad, L. Stoller, R. Ricci, M. Hibler, J. Lepreau, "Scaling Network Emulation with Multiplexed Virtual Resources," refereed poster, *ACM SIGCOMM 2003 Conference*, August 2003.

B. White, S. Guruprasad, M. Newbold, J. Lepreau, L. Stoller, R. Ricci, C. Barb, M. Hibler, A. Joglekar, "Netbed: An Integrated Experimental Environment," refereed poster, *ACM SIGCOMM 2002 Conference*, August 2002; abstract in *ACM SIGCOMM Computer Communication Review (CCR) 32(3)*, July 2002. [Acceptance rate 30%]

S. Guruprasad and J. Lepreau, "Emulab: A Public Emulation Platform for Research in Distributed Systems and Networks," refereed poster, *International Conference on High Performance Computing*, Hyderabad, India, December 2001.

J. Lepreau, C. Alfeld, S. Guruprasad, M. Hibler, M. Newbold, R. Ricci, L. Stoller, B. White, "emulab: A Public Emulation Platform for Research in Distributed Systems and Networks," refereed poster, *18th ACM Symposium on Operating Systems Principles*, October 2001.

B. Ford, M. Hibler, J. Lepreau, "Using Annotated Interface Definitions to Optimize RPC," refereed poster, *15th Symposium on Operating Systems Principles*, ACM, Copper Mountain, CO, December 1995, pg. 232.

Submitted for Publication

M. Hibler, R. Ricci, J. Duerig, S. Guruprasad, L. Stoller, T. Stack, J. Lepreau, "Virtualization Techniques for Network Experimentation," submitted for publication to SIGCOMM 2004, February 2004. Also Flux Group Technical Note 2004-01, http://www.cs.utah.edu/flux/papers/virt-ftn2004-01.pdf.

Publications – Other

C. Barb and J. Lepreau, "Fast Multicast Disk Loading," selected undergraduate poster, Utah State Capitol, January 2002.

"Knit User's Manual and Tutorial," Version 1.0.0, by the Flux Research Group, February, 2001. 40 pages. ftp://flux.cs.utah.edu/flux/knit/1.0.0/manual.pdf

"Session Summaries from the 17th Symposium on Operating Systems Principles," ACM SIGOPS Operating Systems Review, April 2000, 36 pages. Editor and contributor.

"NodeOS Interface Specification," Active Network NodeOS Working Group, http://www.cs.utah.edu/flux/papers/nodeos.ps, Larry Peterson editor, January 10, 2001. Contributor.

"Final Report for the Fluke Security Project," 25 pages, http://www.cs.utah.edu/flux/papers/report-sec.ps.gz, November 1999.

"Final Report for the Fluke Project," 32 pages, http://www.cs.utah.edu/flux/papers/report-base.ps.gz, November 1999.

"Janos Component Manual," by the Flux Research Group, http://www.cs.utah.edu/flux/janos/doc/compman/, October 19, 1999. Contributor.

"The OSKit: The Flux Operating System Toolkit," 546 page tutorial and reference document, by the Flux Research Group, ftp://flux.cs.utah.edu/flux/oskit/doc/, multiple editions, from December 1998 – March 2002.

"Report on the Second Symposium on Operating System Design and Implementation," ";login: The Usenix Association Newsletter," Volume 22, Number 1, February 1997, pp. 36–48. Editor and contributor.

"Online Record, First Symposium on Operating System Design and Implementation," http://www.cs.utah.edu/~lepreau/osdi94/, March 1995.

Publications – Technical Reports

J. Regehr, A. Reid, K. Webb, J. Lepreau, "Composable Execution Environments," Flux Group Technical Note 2002-02, May 2002, 14 pages.

R. Morelli and J. Lepreau, "Magic Windows: An Approach to Verifying Anonymity," December 2001, 5 pages, http://www.cs.utah.edu/flux/papers/anonmagic.ps.

J. Lepreau, C. Alfeld, D. Andersen, M. Hibler, M. Newbold, A. Reid, R. Ricci, L. Stoller, "An Emulation Platform for Research in Distributed Systems and Networks," UUCS-01-010, March 2001, http://www.cs.utah.edu/flux/papers/emulab.pdf.

G. Back, P. Tullmann, L. Stoller, W. Hsieh, J. Lepreau, "Java Operating Systems: Design and Implementation," UUCS-98-015, August 1998.

R. Spencer (SCC), S. Smalley (NSA), P. Loscocco (NSA), M. Hibler, D. Andersen, J. Lepreau, "The Flask Security Architecture: System Support for Diverse Security Policies," UUCS-98-014, August 1998.

B. Ford, M. Hibler, J. Lepreau, R. McGrath, P. Tullmann, "Interface and Execution Models in the Fluke Kernel," UUCS-98-013, August 1998.

D. Orr, J. Lepreau, J. Law, "Program Specialization Using the OMOS System," UUCS-95-016, March 1995.

B. Ford, M. Hibler, J. Lepreau, "Using Annotated Interface Definitions to Optimize RPC," UUCS-95-014, March 1995.

B. Ford, M. Hibler, J. Lepreau, "Extending the RPC Abstraction: Separating Presentation from Interface," UUCS-94-032, July 1994.

B. Ford and J. Lepreau, "Evolving Mach 3.0 to Use Migrating Threads," UUCS-93-022, September 1993.

B. Ford, M. Hibler, J. Lepreau, "Notes on Thread Models in Mach 3.0," UUCS-93-012, April 1993.

Research Support

Summary: Received as Principal Investigator:

Total	Grants & Contracts	Cash gifts	Equipment	Remodeling	Software
$26,161,253	$22,513,759	$940,500	$2,287,544	$247,750	$171,700

Submitted and In-progress:

PI for $49,996 proposal to BBN, "Enhancing Emulab Link Error Models," subcontract on BBN's proposal to the DARPA BAA 04-11 "Control Plane" program, March 2004.

PI for $1,498,242 Utah portion of a $3,998,242 collaborative proposal with U.C. San Diego, PI Ingolf Krueger, to the NSF Information Technology Research program, "Driving a Distributed Car on the InfoBahn—Enabling the Next Generation of Automobile Design," February, 2004.

Received:

PI for $84,000 equipment gift from Intel's Communication Architecture Division, "IXP2400 Network Processor Boards," December 2003.

PI for $611,800 semi-permanent equipment loan from Internet2, "Adding Real Routers to Netbed, a Public Platform for Research in Distributed Systems and Networks," November 2003 (not included in summary).

PI for $799,562 grant from the NSF Special Projects in Networking program, "Collaborative Research: Rapid Evolution of Transport Protocols" (collaborating PI David Wetherall, University of Washington, $408,594), 10/03–9/06. [Selection rate 6%]

PI for $3,592,248 grant from the NSF Network Research Testbeds program, "Collaborative Research: A Unified Experimental Environment for Diverse Network Technologies" (collaborating PI Paul Barford, University of Wisconsin, $1,000,000), 10/03–9/06 (includes $133,414 subcontract to BBN). [Selection rate 6%]

PI for $800,000 grant from the NSF Major Research Instrumentation (MRI) program, with additional $274,958 University of Utah required match, "Development of Next-Generation Network Research Testbeds," 9/03–8/08.

PI for $15,000 Research Experiences for Undergraduates Supplement to NSF grant "A Grid for Research and Education in Distributed Systems and Networks," June 2003.

PI for $12,500 Research Experiences for Undergraduates Supplement to NSF grant "A Large-Scale Highly-Configurable Network Emulation Facility," May 2003.

PI for $206,420 equipment grant from Cisco Systems, "Enhancing Netbed, a Public Platform for Research in Distributed Systems and Networks," November 2002.

PI for $10,000 software grant from Microsoft Research, "Network Emulation Testbed," September 2002.

PI for $9,981 equipment grant from Intel Research (Berkeley Lablet), "PlanetLab Infrastructure," June 2002.

PI for $1,547,876 grant from NSF Information Technology Research program, "A Grid for Research and Education in Distributed Systems and Networks," September 2002 – August 2007 (includes subcontracts totaling $225,251 to Duke, Brown, and Mount Holyoke).

PI for $310,431 grant from NSF Embedded and Hybrid Systems program, "Composable Execution Environments: A Foundation for Building Robust Embedded Systems," July 2002 – June 2005 (co-PI John Regehr).

PI for $15,000 Research Experiences for Undergraduates Supplement to NSF grant "A Large-Scale Highly-Configurable Network Emulation Facility," April 2002.

PI for $30,000 cash gift from Hewlett-Packard Laboratories, "Emulab Network Testbed," March 2002.

PI for $200,000 additional tasking on "Janos" grant from DARPA, "ANTS Prototype Development and Maintenance," February 2002.

PI for $46,871 additional tasking on "Janos" grant from DARPA, "Janos Demonstration," February 2002.

PI for $50,000 cash grant from Intel's Communication Architecture Division, "Integrating Specialized Network Processors in the Emulab Network Testbed," November 2001.

PI for $231,030 equipment grant from Cisco systems, "Emulab Network Testbed," October, 2001.

PI for $87,913 additional tasking on "Janos" grant from DARPA, "Janos Demonstration," 2001.

PI for $25,000 cash gift from Microsoft Research, "Network Emulation Facility," October 2001.

PI for $220,000 equipment grant from Intel's Communication Architecture Division, "Network Processor Evaluation Boards and PCs," May 2001.

PI for $99,200 software grant from Microsoft Research, "Network Emulation Testbed," March 2001.

PI for $15,385 equipment gift from Intel's Communication Architecture Division, "Network Processor Evaluation Boards," January 2001.

PI for $1,998,135 grant from NSF, "A Large-Scale Highly-Configurable Network Emulation Facility," October 2000–September 2003.

PI for $26,000 cash gift from Cisco Systems, "Network Testbed," November 2000.

PI for $659,860 equipment gift from Cisco Systems, "Network Testbed," July 2000.

PI for $24,000 equipment gift from Nortel Networks, "Active Network Testbed," April 2000.

PI for $2,900,000 grant from the Defense Advanced Research Projects Agency, "ALCHEMY: Transmuting Raw Code into Robust Components," June 2000–June 2004.

PI for $21,000 equipment gift from Nortel Networks, "Active Network Testbed," March 2000.

PI for $103,026 grant from the Research Instrumentation Fund, University of Utah, "A Large-Scale Network Testbed," June 1999.

PI for $25,000 cash gift from Novell Corporate Research and Development, "Flux Research," May 1999.

PI for $2,826,411 grant from the Defense Advanced Research Projects Agency, "JANOS: A Java-based Active Network OS," June 1999–May 2002.

PI for $108,500 equipment gift from Digital Equipment/Compaq Computer Corporation, "Active Network Testbed," September 1998.

PI for $25,000 cash gift from Novell Corporate Research and Development, "Flux Research," May 1998.

PI for $10,000 planning grant from the Utah Centers of Excellence Program, "Center for Systems Software," 1998–1999.

PI for $50,000 cash gift from Novell Corporate Research and Development, "Flux Research," November 1996.

PI for $2,542,987 grant from the Advanced Research Projects Agency, "Mach 4 Kernel and IDL Infrastructure for Security," 1996–1999.

PI for $502,000 option granted on the "Fast and Flexible Mach-based Systems" contract, Advanced Research Projects Agency, 1995–1998.

PI for $253,368 IBM Shared University Research equipment grant, December 1995.

PI for $4,104,092 contract from the Advanced Research Projects Agency, "Fast and Flexible Mach-based Systems," July 1994–December 1997.

PI for $247,750 in remodeling funds to support OS/security research and a networking/OS research laboratory, University of Utah, June 1995.

PI for $75,000 cash and $354,000 equipment gift from the Hewlett-Packard Research Grants Program, "Mach-based Research," July 1994.

Research Associate on $1,416,335 National Institutes of Health grant "Institutional Training Grant in Genomic Science" (T32), 1995–2000.

Consultant on $2.3 million grant to Applied Medical Informatics by the NIST Advanced Technology Program, "An Expert Knowledge Server with a General Vocabulary Interface," 1995–1998.

PI for $70,000 cash gift from Open Software Foundation, "Mach Migrating Threads," 1993.

PI for $8,000 cash gift from Cygnus Support, "Portable Language Tools" (renewal), 1993.

PI for $8,000 cash gift from Cygnus Support, "Portable Language Tools," 1993.

PI for $12,500 cash gift and $62,500 software gift from Centerline Software, "Portable Debugging Tools," 1993.

PI for $250,000 cash gift from the Hewlett-Packard Research Grants Program, "Flexible Operating System Structuring," 1993.

PI for $200,000 cash gift from Stratus Computer Corporation, "Operating System Structuring," 1992.

PI for $100,000 cash gift from Hewlett-Packard's Open Systems Software Division, "Portable Dynamic Linking," 1992.

PI for $100,000 equipment gift from Hewlett-Packard Laboratories, "Operating System Support for High Speed Networking," 1992.

Co-PI for numerous gifts of cash and equipment from Hewlett-Packard Corporation, totaling over $2.4M in equipment and $830,000 in cash, 1988–1992 (with R. Kessler).

Co-PI for $46,921 grant from Hitachi-America, "GNU Tools for the PA-RISC," 1991 (with R. Kessler).

Co-PI for $20,000 University of Utah Research Instrumentation grant, "Hierarchical Storage System," 1991 (with R. Kessler).

Co-PI for $9,600 University of Utah Research Instrumentation grant, "Enhancing the Systems Software Laboratory," 1990 (with R. Kessler).

PI for $36,000 cash gift from Open Software Foundation, "Mach on M68000," 1989.

Teaching

"Emulab Software Internals," two-day tutorial for 13 people from 7 external groups, University of Utah, November 3–4, 2003, organizer and a presenter (with the Emulab team).

CS 5480/6480, Networking and Data Communications, 59 students, Fall 2002

"How to Use the "Netbed" (Emulab++) Public Network Testbeds," half- and full-day tutorial at *ACM SIGCOMM 2002 Conference*, August 2002 (with R. Ricci and M. Newbold)
[Tutorial acceptance ratio 20%; rating by attendees approximately 4.7 out of 5]

CS 6935, Computer Systems Laboratory Seminar, Spring 2002

CS 6935, Computer Systems Laboratory Seminar, Fall 2001

CS 6935, Computer Systems Laboratory Seminar, Spring 2001 (co-led with Al Davis)

CS 6935, Computer Systems Laboratory Seminar, Spring 1999 (co-led with John Carter)

CS 6935, Computer Systems Laboratory Seminar, Fall 1998 (co-led with Sally McKee)

Operating Systems "Journal Club," Fall 1997

Operating Systems "Journal Club," Spring 1997

Operating Systems "Journal Club," Winter 1997

CS 686, Computer Systems Laboratory Seminar, Fall 1996 (co-led with Jeffrey Turner)

CS 686, Computer Systems Laboratory Seminar, Winter 1996

Operating Systems "Journal Club," Fall 1995

CS 686, Computer Systems Laboratory Seminar, Winter 1995

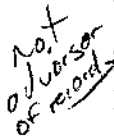
CS 686, Center for Software Science Seminar, Spring 1991

Several guest lectures, CS 506 (Operating Systems), 1991–1996.

"Mach Tutorial" (all day), *Hewlett-Packard Network Architecture Lab*, Cupertino, CA, December 1992 (with my students/staff)

Supervised numerous independent study projects.

Advisor to Masters Students



Siddarth Aggarwal, M.S. "Research in Progress," commenced January 2004.

Mac Newbold, M.S. "Reliability and State Machines in an Advanced Network Testbed," commenced August 2001, graduation expected May 2004 (now successful founder of local software company).

Shashi Guruprasad, M.S. "Issues in Hybrid Network Experimentation using Simulation and Emulation," commenced May 2001, graduation expected May 2004.

Abhijeet Joglekar, M.S. "High Capacity Network Link Emulation using Network Processors," commenced May 2001, defended December 2003, graduation to be May 2004 (now at Intel).

Parveen Patel, M.S. "Hybrid Resource Control for Fast-path Active Extensions," commenced May 2001, thesis defended August 2003; graduated (now at Microsoft).

Kevin Van Maren, M.S. "The Fluke Device Driver Framework," thesis defended May 1999; graduated.

Patrick Tullmann, M.S. "The Alta Operating System," thesis defended March 1999; graduated (now at VMWare).

Unofficial Advisor to Students

Sidney G. Bytheway, "TrISH—Transparent Integrated Storage Hierarchy," M.S. thesis defended August 1995; graduated.

Paul Roberts, "Implementation and Evaluation of Data Breakpoints Schemes in an Interactive Debugger," M.S. thesis defended April 1995; graduated.

Advisor to Undergraduate Students

Cory Steffen, Engineering Scholar, commenced January 2004.

Jonathon Duerig, commenced October 2003.

David S. Anderson, commenced August 2003.

Russell Christensen, Computer Engineering senior thesis advisor, commenced January 2002.

Jason Morgan, Honor's thesis advisor, January–September 2001 (changed interest and topic).

Chad Barb, commenced September 2000; also senior thesis advisor; B.S. received May 2003 (now at Sensory Sys).

Robert Ricci, commenced November 2000; also Honor's thesis advisor; B.S. received August 2001 (now Flux research staff and author of several papers).

Mac Newbold, commenced January 2000; B.S. received May 2001.

Timothy Stack, June 1998 – August 1998, B.S. received August 1998 (now Flux research staff and paper author).

Eric Pabst, February 1997 – March 1998.

Christopher Alfeld, commenced August 1996, B.S. Computer Science received May 2000, B.S. Mathematics received May 2001 (now Wisconsin Math Ph.D. student).

Bartholomew Robinson, August 1995 – August 1998, B.S. received August 1998 (now at Inktomi/Yahoo).

David G. Andersen, December 1997 – June 1998, B.S. received June 1998. (now MIT CS Ph.D. student and top 2004 systems faculty candidate).

Bryan A. Ford, September 1992 – November 1997, B.S. received June 1998 (now MIT CS Ph.D. student).

James Simister, August 1997 – June 1998, B.S. received June 1998 (now at emWare).

Kevin Frei, February 1996 – June 1997, B.S. received June 1997 (now at Microsoft).

Nathan Dykman, January 1995 – June 1996, B.S. received June 1996 (now Utah Ph.D. student).

Unofficial Co-advisor to Students

Linus Kamb, "Extending Fluke IPC for Transparent Remote Communication," M.S. received December 1998 (advised with J. Carter).

Ajay Chitturi, "Implementing Mandatory Network Security in a Policy-flexible System," M.S. received June 1998 (advised with G. Lindstrom) (now at Microsoft).

Peter J. Hoogenboom, "System Performance Advisor: an Expert System for UNIX System Performance Management," M.S. received January 1992 (advised with R. Kessler).

Douglas B. Orr, 1992 – 1995 (advised with J. Carter) (now VP Engineering at Arbor Networks).

Stephen Clawson, undergraduate, B.S. received July 1995 (advised with J. Carter) (now at Alcatel).

Member of Graduate Committee

Roland Kempter, Ph.D. ECE Department, "High-capacity Wireless Access Protocols."

Jason Baker, M.S., "Maya: Multiple Syntax Extension in Java," proposal defended October 1999. thesis defended June 2002, graduated.

Yury Izrailevsky, M.S., "Supporting Persistent Java Objects in a Distributed Storage System," proposal defended October 1999.

Godmar Back, Ph.D. "Isolation and Sharing in a Multi-Process Java Virtual Machine," dissertation defended June 2001; graduated.

Anand Ranganathan, M.S., "Design and Implementation of KOLA," proposal defended November 1998.

Sai R. Susarla, Ph.D., "Flexible Wide Area Consistency Management," proposal defended September 2001.

Dilip R. Khandekar, "Quarks: Distributed Shared Memory as a Basic Building Block for Complex Parallel and Distributed Systems," M.S. thesis defended January 1996; graduated.

Post-doctoral Fellows

John Regehr, April 2001 – June 2003.

Visitors

Scientists:
Dr. Kota Abe, Osaka City University, Osaka, Japan, March 28, 2000 – March 27, 2001.

S. Jeffrey Turner, Computer Scientist, Office of Information Security Research, NSA, Baltimore, MD, 1996–97

Stephen D. Smalley, Computer Scientist, Office of Information Security Research, NSA, Baltimore, MD, 1996–97

Ph.D. Students:
Brian White, University of Virginia, September 2001–August 2002.

Todd Miller, University of Wisconsin, summer 2001.

John Regehr, University of Virginia, Fall 2000–Spring 2001.

Chris Hawblitzel, Cornell University, Summer 1999.

Gregory Benson, University of California at Davis, 1997

Honors

"Outstanding Investigator Award, for Excellence in Academic Research," DARPA (ITO/Active Networks), December 2001.

The Usenix Association "Lifetime Achievement Award" to U.C. Berkeley's Computer Systems Research Group, "Major Contributor," awarded 1993.

Josephine Beam Scholarship – Department of Computer Science, University of Utah, 1980

National Merit Scholar, 1970

Students' Honors

Robert Ricci, special letter of commendation for honors thesis, July 2001.

David Andersen, College of Engineering, University of Utah. Outstanding Graduating Senior Student Leader Award, 1998.

Bryan A. Ford, Computing Research Association, first Outstanding Undergraduate Award, 1995.

Bryan A. Ford, Barry M. Goldwater Scholar, 1994.

Formally Distributed Software and Services

All publically released software is available from http://www.cs.utah.edu/flux/, and all is open source.

CPU Broker 1.0, a reservation-based resource manager for CPU time, 12/03.

CMI 1.0, a flexible Cross-Module Inliner for C, 11/03.

Frisbee high-speed disk imager, 6/03, 10/03.

Prototype implementation of an emerging part of the Java standard, JSR-121 (Isolates), which provides an API for reliably controlling separate computational entities. *First publically available JSR-121 implementation.* Part of JanosVM release 1.0, February, 2003.

"Bees" secure Java-based active network execution environment, including 31 page manual and tutorial, December 2002.

Netbed 0.1–0.3 bootable CDROM for the geographically distributed testbed, including 200 copies distributed at SIGCOMM, August 2002–December 2002, http://www.emulab.net/cdrom.php

"Emulab Software," many releases to collaborators, October 2001–present.

"JanosVM" – A Flexible Multiprocess Java Virtual Machine, with 49 page user's manual and tutorial, four formal releases, 0.5–1.0, 5/01–2/03, http://www.cs.utah.edu/flux/janos/

"Knit" component composition toolset, release 1.0.0, February 2001, http://www.cs.utah.edu/flux/knit/

"ANTS 2.0" Active Network execution environment, February 2001, March 2002, http://www.cs.utah.edu/flux/janos/

"Janos Java NodeOS" v1.1.5, February 2001, March 2002, http://www.cs.utah.edu/flux/janos/

"Emulab/Netbed" public network emulation facility and testbed:
phase 0.5 10/00, phase 1.0 3/01, phase 2.0 11/01, phase 3.0 3/02, phase 4.0 with wide-area support 5/02, simulation support 12/02, multiplexed virtual resources 8/03, PlanetLab nodes 9/03, IXP network processor nodes 10/03. http://www.emulab.net/

"Moab" – Active Network NodeOS implementation in C:

six formal snapshots, 12/99–3/02, http://www.cs.utah.edu/flux/janos/

"Janos Java libraries":
• Active Network "NodeOS" implementation in Java,
• ANTSR Active Network execution environment;
six formal snapshots and releases 1.0, 9/99–3/02, http://www.cs.utah.edu/flux/janos/

The OSKit (Flux Operating System Toolkit):
nine formal snapshot releases from April 1999 through March 2002,
release 0.97 (January '99) – 1397 downloads,
release 0.96 (December '98) – 961 downloads,
interim release 0.95 to collaborators (June'98), release 0.6 (September '96), release 0.5 (July '96),
http://www.cs.utah.edu/flux/oskit/

Flexible IDL Compiler Kit (Flick):
release 2.1 (November 1999), selected as part of BBN's Quality Objects framework, QuOIN-2.1; release 2.0 (August 1999), release 1.1 (May 1998): 931 downloads, release 1.0 (November 1997), public alpha release (April 1997), interim release to collaborators (March 1997), limited alpha test release (August 1996), http://www.cs.utah.edu/flux/flick/

Fluke kernel code and documentation, release 0.5 (February 1999), ftp://flux.cs.utah.edu/flux/fluke/

Kaffe Java Virtual Machine modified to run on the OSKit (bare hardware):
release 0.97 (January '99) – 253 downloads, release 0.96 (December '98) – 211 downloads,
http://www.cs.utah.edu/flux/oskit/kaffe/

Active Node Transfer System (ANTS) modified for resource control, release 1.2.u1 (June 1998),
http://www.cs.utah.edu/flux/java/index.html#JANOS

Fluke IPC Modeled in Promela: public snapshot release (March 1997),
http://www.cs.utah.edu/flux/formal/html/

Fluke Distributed IPC server: snapshot to collaborators at Sandia National Labs (February 1997)

Fluke kernel code and documentation to collaborators at the NSA and Secure Computing Corporation (March 1996)

Object/Meta-Object Server (OMOS) on x86 and PA-RISC to OSF Research Institute (March 1996)

Mach 4 kernel and Lites Unix server with new IPC system, supporting unmodified Linux device drivers, Linux filesystems, and HP-UX emulation (Fall 1995), http://www.cs.utah.edu/flux/

"Quarks" portable DSM system, beta release (September 1995), (John Carter, primary responsibility),
http://www.cs.utah.edu/flux/quarks.html

Completely unencumbered snapshot of Mach 4 kernel, Lites Unix server, ELF compiler tool chain, Unix utilities on PA-RISC (December 1994), http://www.cs.utah.edu/flux/mach4-parisc/html/pamach.html

Mach 4 kernel, boot, and build environment on x86 (August 1994),
http://www.cs.utah.edu/flux/mach4/html/Mach4-proj.html

GNU language tool suite (compiler/debugger/assembler/linker/BFD library, for both SOM and ELF object formats) on PA-RISC (updated quarterly, 1991–1995), ftp://flux.cs.utah.edu/dist/pagnutools.html

Mach migrating threads to OSF Research Institute (November 1993)

Mach 3.0, OSF/1 server for PA-RISC (annual releases 1991-1994)

HP700/HP300 BSD 4.3.8 (1993, 1994)

HP300 BSD 4.3 (1988, 1989)

"ded" directory editor (periodic releases 1983-1993), ftp://ftp.cs.utah.edu/pub/ded.tar

"pcc-20" C compiler for DEC-20, 1981–1984, (Resulted in $75,000 for the department from sales to commercial sites and a $75,000 grant from DEC.)

Other Refereed Presentations

"A Testbed for Research in Distributed Systems and Networking," *17th ACM Symposium on Operating Systems Principles, Work-in-Progress Session*, Kiawah Island, SC, December 1999.

"A Large-Scale Network Testbed," *ACM SIGCOMM Conference, New Research Session*, Harvard University, September 1999.

"Nested Java Processes," *1998 IEEE Symposium on Security and Privacy, Work-in-Progress Session*, Oakland, CA, May 1998.

"Porting PCC to a Word-Addressed Architecture," *Summer Usenix Conference*, June 1982.

Invited Presentations

[Presentations of refereed papers and at DARPA PI meetings are not included.]

"Emulab/Netbed: Recent Developments, Future Plans," *USC ISI*, Marina del Rey, November 20, 2003.

"Emulab Portal to PlanetLab ("Netbed"), *PlanetLab Workshop, RPI*, Troy, NY, October 19, 2003.

Keynote address: "Reproducible Network Research: What Is It? ... and Some Modest Proposals," *Workshop on Models, Methods and Tools for Reproducible Network Research (in conjunction with ACM SIGCOMM 2003)*, Karlsruhe, Germany, August 25, 2003.

Colloquium: "An Integrated Experimental Environment for Distributed Systems and Networks," *University of Wisconsin-Madison, Computer Science Department* March 14, 2003.

"Emulab: History and Lessons," *NSF Workshop on Network Research Testbeds*, Chicago, IL, October 17, 2002.

"Lessons from Emulab/Netbed," *Workshop on Accelerating Trustworthy Internetworking*, Palo Alto, CA, September 2002.

"Highlights of the Emulab/Netbed Experimental Environments," *Intel Research @ Berkeley*, August 2002.

"Emulab: An Integrated Experimental Environment for Distributed Systems and Networks," *Intel IXA University Workshop*, June 5, 2002.

"Emulab: A New Kind of Public Network Testbed," *NSF CISE, Advanced Network Infrastructure and Research Division*, April 4, 2002.

Invited member and presenter, "Emulab: Its Lessons and Value for a Distributed Testbed," *Workshop on Developing a Planetary Testbed, Intel Research @ Berkeley*, March 20, 2002.

Invited member and presenter, "Beyond Active Networks," *DARPA Workshop on Next Generation Active Networking*, Orlando, FL, December 5–6, 2001.

"An Emulation Testbed for Networks and Distributed Systems," *Brown University Computer Science Department*, November 2, 2001.

"From libkern.a to COM to Knit: Three Generations of Component Models for Low-level Systems," *Brown University Computer Science Department, 28th IPP Symposium*, theme "Component Software and Technologies," November 1, 2001.

"emulab.net: An Emulation Testbed for Networks and Distributed Systems," *Intel IXA University Workshop*, June 21, 2001.

"Overlay Networks: Threat or Menace?" in panel session "Peer-to-Peer Overlays: Active Network Prospect or Challenger?", *Fourth IEEE Conference on Open Architectures and Network Programming (OpenArch 2001)*, Anchorage, AK, April 2001.

"The Role of Undergraduates in the Flux Research Group," presentation to high school teachers attending the *ACM 2001 Utah High School Programming Contest*, March 2001.

"An Emulation Facility for Research," *Mount Holyoke College, Dept. of Computer Science*, October 2000.

"Advanced Component Architectures," *Palm Computing*, September 2000.

"Cluster or Network? An Emulation Facility for Research," Symposium on Cluster Computing in Geophysics and the Sciences, *Center for High Performance Computing, Univ. of Utah*, February 2000.

"Perspectives on Mobility and Security," *DARPA Information Science and Technology study group*, Carnegie-Mellon University, January 2000.

"Towards Robust Composition of Components for Low-level Systems," *NSA/DARPA study group on "Secure Open Source Operating Systems,"* Arlington, VA, November 1999.

"Computer Security: Threat or Menace?" presentation to high school teachers attending the *ACM 1998 Utah High School Programming Contest*, March 1998.

"A Java-based Operating System," *Salt Lake Java SIG*, February 1998.

"What the OS Industry Wants from OS Research (panel)," invited organizer and moderator, *OSDI '96*, Seattle, WA, October 1996.

"Encapsulated Environments using the Flux Operating System," in panel session "Secure Systems and Access Control," *National Information Systems Security Conference*, Baltimore, MD, October 1996.

"Interprocess Communication in Mach4," *Open Software Foundation Research Institute OS Symposium*, Cambridge, MA, April 1995.

"Mach4 Virtual Memory Design," *Open Software Foundation Research Institute OS Symposium*, Cambridge, MA, April 1995.

"Highlights of the Symposium on Operating Systems Design and Implementation," *1995 Usenix Conference*, New Orleans, LA, January 1995.

"Mach Research at the University of Utah," Mach interest group, *First Symposium on Operating Systems Design and Implementation*, Monterey, CA, November 1994.

"Mach 4.0 Research," *Novell Architecture Group*, Provo, UT, November 1994.

"Evolving the RPC Abstraction: Separating Presentation from Interface," *Open Software Foundation Research Institute OS Symposium*, Cambridge, MA, October 1994

"Mach-based R & D at the University of Utah," *Novell/Sun Microsystems/CCL*, Provo, UT, June 1994.

"An Evolutionary Shared Address Space System," *Open Software Foundation Research Institute OS Symposium*, Cambridge, MA, April 1994.

"Evolving Mach 3.0 to a Migrating Thread Model," *Open Software Foundation Research Institute OS Symposium*, Cambridge, MA, October 1993.

"Decomposing the Mach 3.0 Task Abstraction," *Open Software Foundation Research Institute Symposium*, Cambridge, MA, October 1993.

"Routes to a Decomposed Operating System," *Hewlett-Packard Open Systems Software Division*, Cupertino, CA, October 1993.

"Evolving Mach 3.0 to a Migrating Thread Model," *Open Software Foundation Research Institute*, Cambridge, MA, September 1993

"Fast Yet Flexible Shared Libraries Using the OMOS Object Server," *Open Software Foundation*, Cambridge, MA, October 1992.

"Mach on the PA-RISC," *Hewlett-Packard*, Cupertino, CA, January 1991.

"Mach 3.0, Virtual Memory, GNU tools on PA," *HP Apollo Systems Division*, Chelmsford, MA, November 1991.

"BSD Unix on HP300," *U.C. Berkeley*, Berkeley, CA, May 1988.